

# COLTMA VOLCANO: FOURTH INTERNATIONAL MEETING

## ABSTRACT

### MONITORING AND MAPPING VOLCANOES USING REMOTE SENSING

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Monitoring and mapping VOI canoes using remet, e sensing supports vari ous V03 canol ogical science objec tives : providing a better understanding of past eruptive behavi or; detect ing anti monitoring ash -plumes; contri but ing to determi nation of gl obal "SO2 budgets; quantifying the volume of volcanic products; improving VOI canic hazards maps; and providing warnings to aircraft of plume hazards, among others.

Much of the gl obal observation and monitoring of volcanoes present.] y makes use of five satellit. e systems : 1) the French satellite SPOT provides high spatial resolution (10m) panchromatic data, once every five days; each image covers a 60x60 km area; it can be used to map landscapes anti cl-ranges, such as lava flows; 2) Landsat Thematic Mapper provides 30m multi spectral data once every 16 days, covering areas of 185x185 km; it can also be used for mapping, but additionally the data allow calculat ion of temperatures and energy fluxes for small to extended high temperature volcanic phenomena, such as fumarol es, lava flows, domes, etc. ; a 120m resolut i on thermal band adds supplementary thermsl i nformation, allowing observati on of low temperature (<100C) targets; 3) AVHRR and GOES provide low spatial resolution (1km) multi spectral data several times per. day; these data can be used to monitor plume evoluti on, and detect and estimate temperatures of large volcanic features; images cover thousands of kilometers; the frequent repeat time are their main advantage; 4) TOMS on the Nimbus satellite is used to map globally stratospheric ozone and SO2 .

Research by us using experimental aircraft scanners has indicated the advantages of other instruments and wavelength bands for monitoring and mapping volcanoes, compared to existing operational systems . Of great utility is multispectral thermal infrared capability (8- 12 micron region) . In addition to allowing more accurate temperature measurements to be made, the data can be processed to extract. emi ssivity variat ions. This is a characteristic of silicate rocks that allows subtle mineralogical

variations to be observed and mapped, thus improving our ability to map historical and prehistoric flow fields. Work at Mt. Etna, in Hawaii, Kamchatka, California, and other sites has demonstrated the value of this approach to improved mapping. Another application of multispectral thermal infrared data is direct measurement of SO<sub>2</sub> emissions from volcanic plumes. The presence of a strong SO<sub>2</sub> absorption band between 8 and 9 microns can be detected, and thus the flux of SO<sub>2</sub> estimated. Results from Mt. Etna and Hawaii have validated the usefulness of this technique as a complement to both ground and aircraft CO SPEC measurements, and TOMS satellite data.

Future satellite instruments will incorporate some of these improved capabilities. The EOS Advanced Spaceborne Thermal Emission Reflection Radiometer (ASTER) instrument, due to be launched in 1998, will combine high spatial resolution panchromatic data, several visible-near infrared-short wave infrared channels, and multispectral thermal infrared capability. The thermal bands will allow direct measurement of optically thin plumes of SO<sub>2</sub> in volcanic emissions and measurement of low temperature volcanic phenomena. Pointability will permit revisiting sites with a frequency of a few days. Planned improvements to the Landsat instruments may also include multispectral thermal channels, stereo capability, and possibly imaging spectrometry capability (data unknown). Dedicated volcanological satellites are being planned for possible launch as Earth Probe Missions. One concept would allow continuous monitoring of northern latitude volcanoes (> 35 degrees) with SO<sub>2</sub>, temperature, and particulate measuring capabilities. A primary application of this satellite would be to monitor hazards and warn aircraft of volcanic plumes along the trans-polar air routes. Two satellites would provide continuous coverage of high northern latitudes, and frequent coverage for other volcanic regions around the globe.